X. *Mimicry of Ants by other Arthropods.* By Horace Donisthorpe, F.Z.S., etc.

[Read June 1st, 1921.]

Mimicry.

Numerous Arthropods are very ant-like in appearance, and such resemblances are not surprising considering that ants are on the whole very well protected. Their protection is brought about by many different causes, especially the vast numbers in some colonies all ready to come to each other's assistance, and overwhelm an enemy by sheer weight of numbers. They also possess various methods of offence and defence — well-developed stings; poison and repugnatorial glands, ejecting acid and offensive discharges; marked odours; hardness of integument; defensive spines, etc., etc. I propose to divide the mimicry of ants into the following sections :—

1. Mimicry of ants by other Arthropods which do not live with them, neither feeding on, nor having any direct association with them. Such mimics are in no way Myrmecophiles, and may be called Simple Myrmecoids. Perhaps the best-known example is the little Locustid *Myrmecophana fallax* found in the Soudan [and perhaps in Rhodesia also; see Poulton "Essays on Evolution," 257 *n.* 1 (1908)]; its resemblance to an ant is brought about by the arrangement of pale colouring beneath and on the sides, and not by the actual shape of the insect. Various spiders, bugs (Heteroptera and Homoptera, including the Membracids with ant-like shields, and the curious larval Membracid resembling an ant carrying a leaf), wasps, Longicorn Coleoptera, all belong to this division, which includes a number of our own beetles belonging to the genera *Clivina*, *Dyschirius*, *Miscodera*, *Stilicus*, *Notoxus*, and *Anthicus*.

The beetle *Clerus formicarius* has also been considered to be an ant-mimic, in which case it would therefore come under this heading. I, however, consider it to be a *Mutilla*-mimic.*

2. Mimicry of ants by other Arthropods which do not

* See Donisthorpe, "Cases of Protective Resemblance, Mimicry, etc., in the British Coleoptera," Trans. Ent. Soc., London, 1901, 376.

live with their models, but do feed on them. These may be called Myrmecoid Myrmecophags. Some spiders, tiger-beetles, etc., may be given as examples.

3. Mimicry of ants by other Arthropods, which both live with the ants, and also feed on them. These are the Myrmecoid Synechthrans. One of the best examples is the jet black *Myrmedonia funesta*, much resembling the ant with which it occurs. Wasmann has expressed his opinion that the object of this mimicry is to deceive the ants; but I am unable to agree with him, considering rather that the likeness protects the beetle from outside enemies; for the beetle when attacked by its host can always defend itself by powerful repugnatorial discharges. In common with other Myrmedonias, it curls up when disturbed, and looks like a fragment of earth, but this is its second line of defence. The insect is frequently found in the "runs" of the ants, at the entrance and outside the nest, where its resemblance to an ant would be of value against the attacks of enemies other than its host.

Some of the mimetic spiders and also bugs (Heteroptera of the genera *Alydus*, *Myrmecoris*, *Systellonatus*, *Nabis*, etc.) may belong to this group, at any rate during the times when they associate with ants as they commonly do. It is also possible that the species referred to prey on their ant models.

4. Mimicry of ants by other Arthropods which are generally found in company with ants, or near their nests, but attack other insects, etc. These are partly Myrmecoid Synoeketes. Species of the genus *Gonatopus* are good examples, as they are very ant-like and often found with ants, but prey on small Homoptera. Some spiders, and the bugs mentioned in the last section possibly belong here, for it is not certainly known whether they feed on the ants. They are all very ant-like, especially in the larval stages, when their bodies are shaped like those of the ants. In *Nabis*, however, the resemblance is brought about in a different manner like that producing the likeness in *Myrmecophana*. The sides of the base of the abdomen are white with a dark mark in the middle like the pedicel of an ant. Viewed in profile there is also an elevation like the ant's scale. This species has been observed to suck the eggs of Lepidoptera, and other species of bugs in the neighbourhood of ants [see Butler, Ent. Mo. Mag., **57**, 80 (1921); and Donisthorpe, Ent. Mo. Mag., **57**, 136 (1921)].

5. Mimicry of ants by other Arthropods which always live with their hosts. This section includes the Myrmecoid Synoeketes, of which the best examples are the guests of the Driver ants (Dorylii) of tropical Africa and Asia, and the legionary ants (Ecitonii) of the warmer portions of America. The species are principally Staphylinid beetles, and among them are some of the most remarkable ant-mimics in the world. As their hosts have no fixed abode these Synoeketes live as camp-followers, moving from place to place in company with the ants, and feeding on the plentiful booty obtained by them. Perhaps the most wonderful of all is the Staphylinid beetle *Mimanomma spectrum*, a Doryline guest, whose whole body is modified in the most extraordinary manner, to imitate that of its hosts.

Mimeciton pulex is also a very curious insect which lives with an *Eciton* in Brazil. Wasmann, to whom we are indebted for our knowledge of nearly all these Doryline guests, considers that the form and hairiness of *Mimeciton* are for the purpose of deceiving its hosts, whilst its ant-like colour protects it from outside enemies when running along in company with *Eciton*. As the Doryline ants are blind, but possess a keen sense of touch, it is highly probable that in such cases as this Wasmann's interpretation is correct.

6. Mimicry of ants by other Arthropods which always live with their hosts, and are fed and licked by them—these are the true guests, or Myrmecoid Symphiles. The Staphylinid beetle *Lomechusa* is always to be found in parts of the nest where the ants are thickest. Here it is to be found sitting amongst and crawling over the ants, and when at rest practically indistinguishable from them. The reason being that the light which is reflected from the concave sides of the thorax appears to the eye like the narrow back of an ant, and the rolled-up abdomen of the beetle reflects the light in the same way as the rounded gaster of a large ant. The species of another Staphylinid genus *Atemeles* are not only ant-like, but also mimic the ants' movements. When an *Atemeles* desires to be fed it not only solicits an ant by tapping with its antennae as does *Lomechusa*, but it further mimics the actions of its hosts by stroking the side of the head of the ant with its front feet. These actions are also performed by the larva of *Xenodusa*, the American representative of *Lomechusa*,

which having longer legs than the larva of the latter, can walk about and solicit the ants for food by raising itself and stroking their cheeks with the anterior pair of feet.

7. Mimicry of ants by other Arthropods which live with the ants, and lay their eggs in them or their brood—Myrmecoid Entoparasites. Mann records the capture in Brazil of several specimens of a remarkable wingless Proctotrypid—*Mimopria ecitonophila*, which runs about in company with the legionary ant *Eciton hamatum*. They were good mimics of the small workers, and very ant-like in their movements. Chitty found in a nest of *Tetramorium caespitum* in Kent a wingless Proctotrypid which resembled very closely this ant. This section also includes various other mimetic *Proctotrypidae*, and probably also some ant-like *Ichneumonidae* of the genus *Pezomachus*, which are found with ants.

8. Mimicry of ants by other ants of different genera—Myrmecoid Formicidae. Forel has commented on the close superficial resemblance between the minor workers of *Colobopsis truncata* and workers of *Dolichoderus 4-punctatus*, considering the likeness to be due to mimicry. These forms of the two species resemble each other in size, gait, and behaviour; both have spotted gasters, being the only European ants with such markings, and both often occur together on walnut-trees. Moreover, *Camponotus lateralis* may also be found with the other two species which they resemble in general colouring and behaviour. Finally, all three sometimes inhabit the same tree as *Cremastogaster scutellaris* and may be looked upon as mimics of the latter ant. I found the *Colobopsis* and the *Cremastogaster* living in the same pieces of "virgin" cork at Kew Gardens accompanied by a beetle *Formicomus pedestris* which closely resembled the *Colobopsis*. It has been suggested that these resemblances are only accidental, but this conclusion is by no means certain. Ants of the genus *Dolichoderus* possess well-developed repugnatorial glands, and the numerous species of *Cremastogaster* are dreaded by other ants. Mann has observed that the Cremastogasters are always avoided by the fierce Brazilian Ecitons, even when marching in column.

Santschi has shown that the female of *Bothriomyrmex decapitans* possesses a similar odour (not present in her own workers) to that possessed by the workers of *Tapinoma nigerrimum*, on which she is a temporary social

parasite. This is a case of olfactory mimicry. [Rev. Zool. Africa, 7, 216 (1920).]

9. Mimicry of Myrmecophiles found together with them in the same ants' nests—Myrmecophile mimics of Myrmecophiles. The "Lady-bird" *Coccinella distincta* is a good example of such mimicry, for it superficially resembles the beetle *Clythra 4-punctata*, and both are found in and about the nests of *Formica rufa*. This is an instance of Müllerian mimicry, as I have shown the *Clythra* to be distasteful to "insectivorous animals," and the *Coccinellidae* are known to be so.

Another example which may be similar to the above is that of an Ichneumonid, *Microcryptus nigrocinctus*, several females of which I found in company with a number of *Myrmedonia collaris* in a nest of *Myrmica laevinodis* at Wicken Fen. The head, elytra, and tip of the abdomen of the beetle are black, and the rest of the surface bright red, and as the Ichneumon is coloured in a similar manner, they bear a strong superficial resemblance to each other.

10. Resemblance to inanimate objects by Myrmecophiles —Protective Resemblance. Before leaving the subject of Mimicry, it may be as well to refer briefly to a few cases of protective resemblance among ants' guests. Species of the genus *Monotoma* when at rest look like bits of wood; and it has already been pointed out that the Myrmedonias, in their second line of defence, feign death and resemble fragments of earth; while the larval cases of *Clythra* and *Cryptocephalus* and the pupal case of *Cetonia*, etc., look like lumps of earth in the nest—these last being examples of "adventitious" or allocryptic resemblance. *Amphotis marginata*, a true guest, is very like a bit of bark, and it is often found under, or on the bark of trees inhabited by its hosts. To these, other instances might be added.